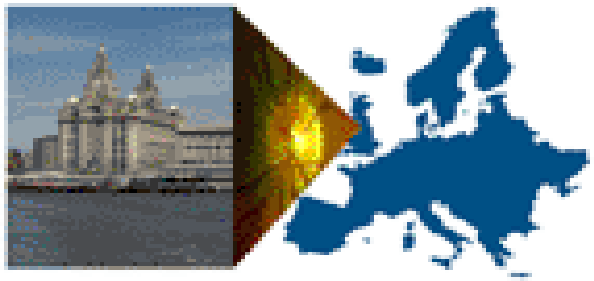

Screening for Diabetic Retinopathy in Europe
Impact of New Technologies

Hardware developments

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23rd June 2016

Discussion

- Latest UWF-imaging sufficient /accurate for screening?
- Hand-held / smartphone technologies good enough for screening?
- Portable / hand-held imaging and OCT’s place
- The role of home monitoring?

Visualization

The visualization tool is essential in DR diagnostics (MA is defined as the earliest detectable lesion in DR). There are earlier and *functional* changes, too, although not (as easily/non-invasively) visualizable - as well as lesions in *different locations* than hitherto of interest or beyond possibility of visualization.

(SD-)OCT

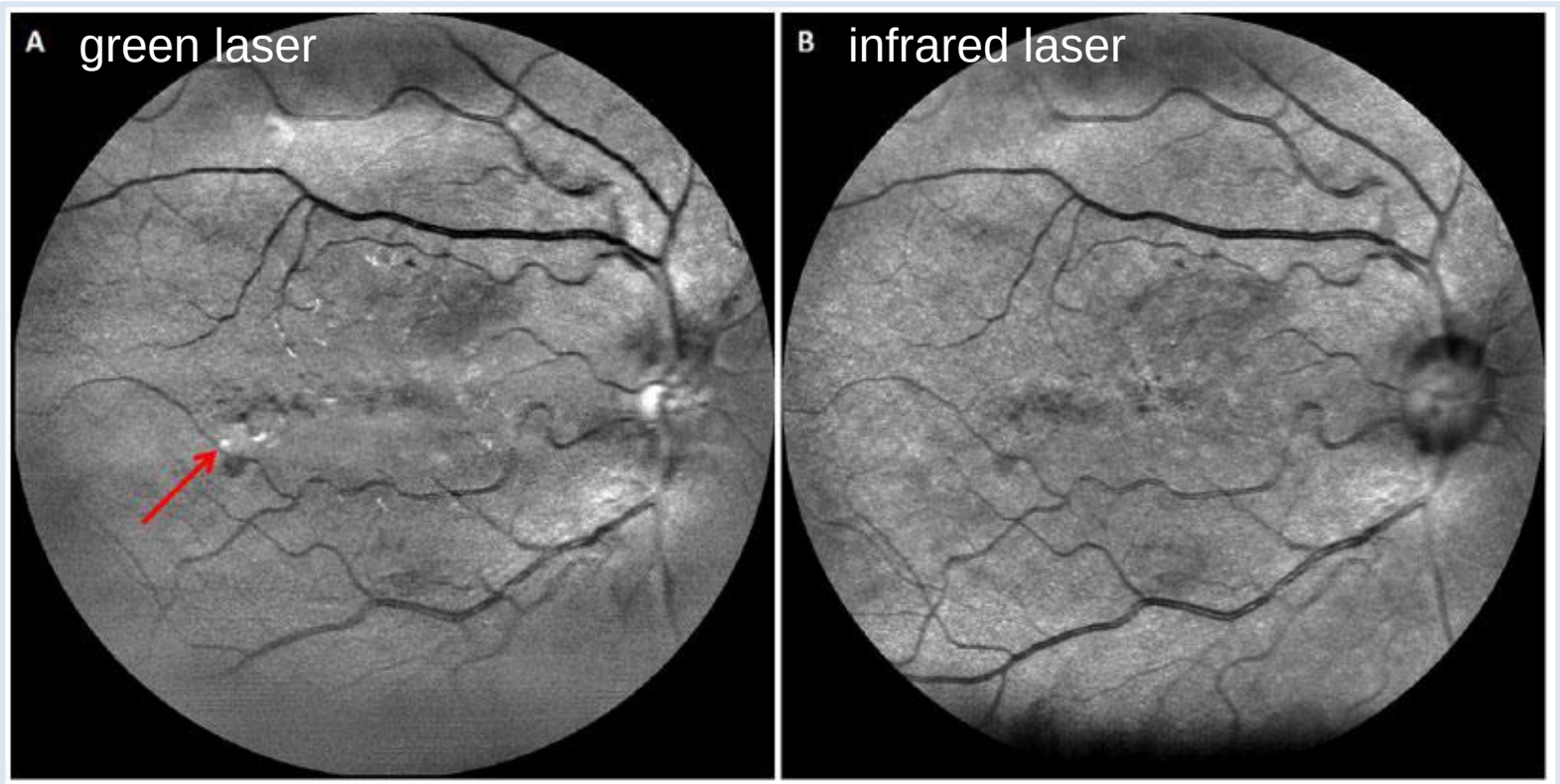
OCT – 3D optical biopsy. Compares favourably to slitlamp and photo (pooled *sensitivity* of 78% and *specificity* of 86% for detecting DME *Virgili G et al 2015 Cochrane Database Syst Rev*) New reference standard for assessment of DME, but unclear role in screening.

26% of pts w/ «*referable DME*» (from fundus photos) had macular thickening on SD-OCT. (*Dodson P et al www.retinalscreening.co.uk/wp-content/uploads/2015/06/OPDR-poster.pdf)* OCT may reduce unnecessary referrals.

Subclinical ME identified by OCT = new biomarker of DR?

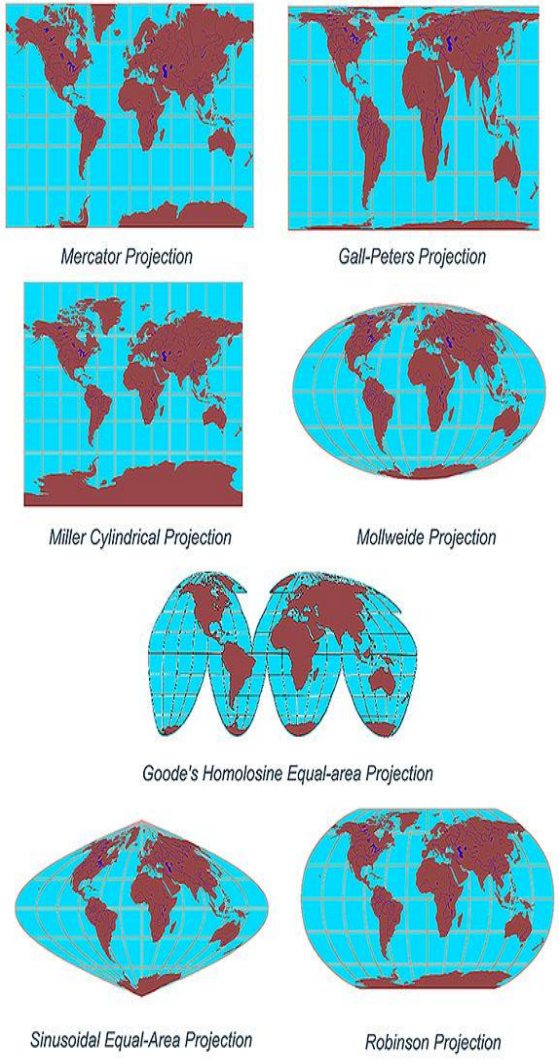
SLO Scanning laser ophthalmoscopy – uses laser.

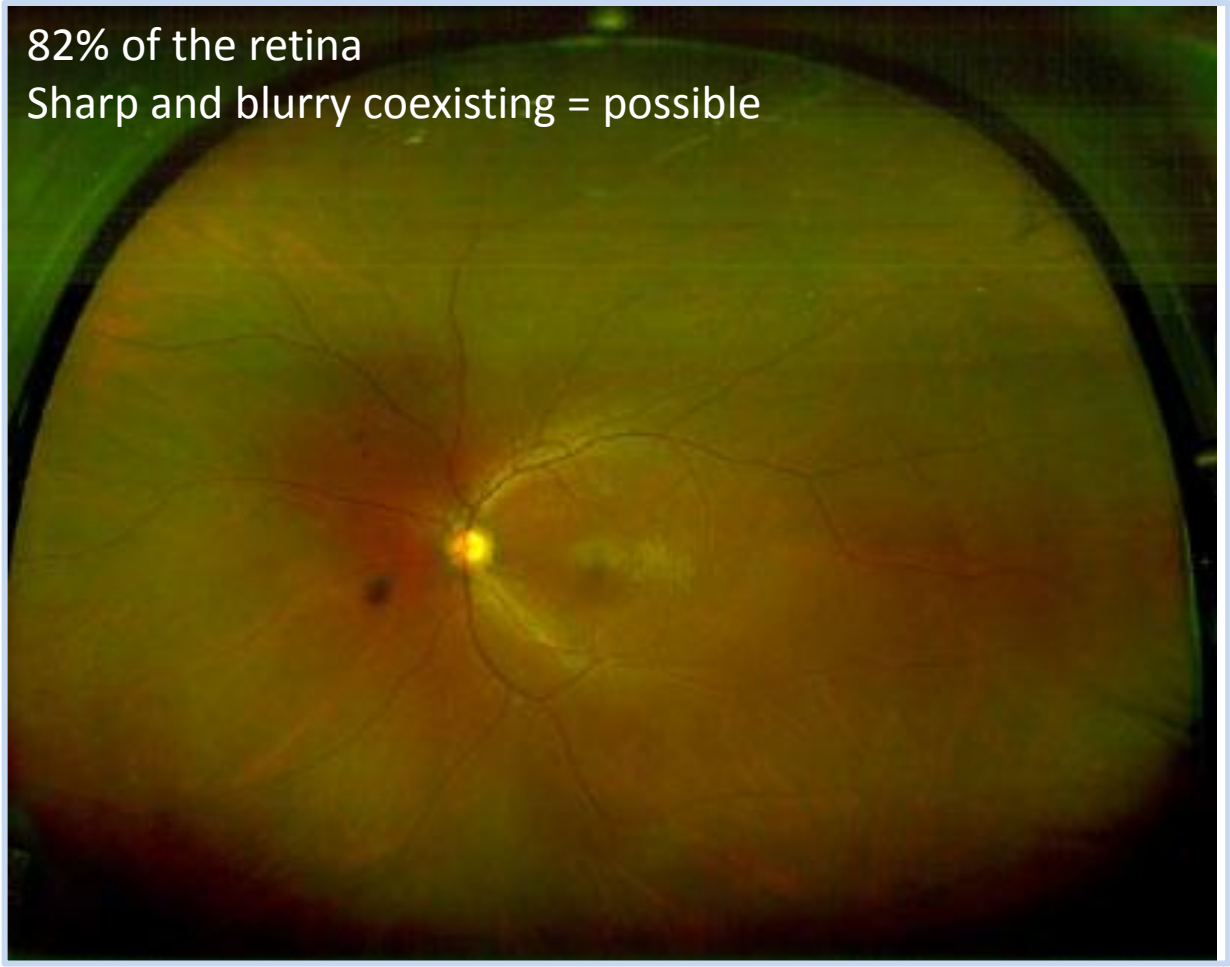
EasyScan (i-Optics,NL) – combines green and infrared lasers in cSLO; images despite media opacities. Gradability higher than undilated FP (*unpublished data; mentioned by James Kang Hao Goh et al in Journal of Diabetes Science and Technology 2016, Vol. 10(2) 282-294*)



UWF image obtained using Optos P200MA (Optos, Marlborough, MA).

Projection is the problem





SLO Scanning laser ophthalmoscopy – uses laser.

Miosis = no problem, like the (extreme) periphery

UWF – uses the principles of confocal laser scanning microscopy and laser light. Combines SLO w/ an ellipsoidal mirror → 200^0 field of view (as opposed to 45 ^{0} or 50^0)

- Optos (Optomap 200Tx, Daytona, California)
- Heidelberg HRA (retina angiograph)

UWF – **sensitivity** of 95% and **specificity** of 84% for identifying more than minimal DR *(Silva PS et al Am J Ophthalmol. 2012;154(3):549-559 e542)*

UWF – Optomap: **Increased** identification of DR by 17%, with lesions in the periphery. Greater disease **severity** in 9% compared w/ non-mydiatric FP *(Silva PS et al, Diabetes Care. 2014;37(1):50-55)*

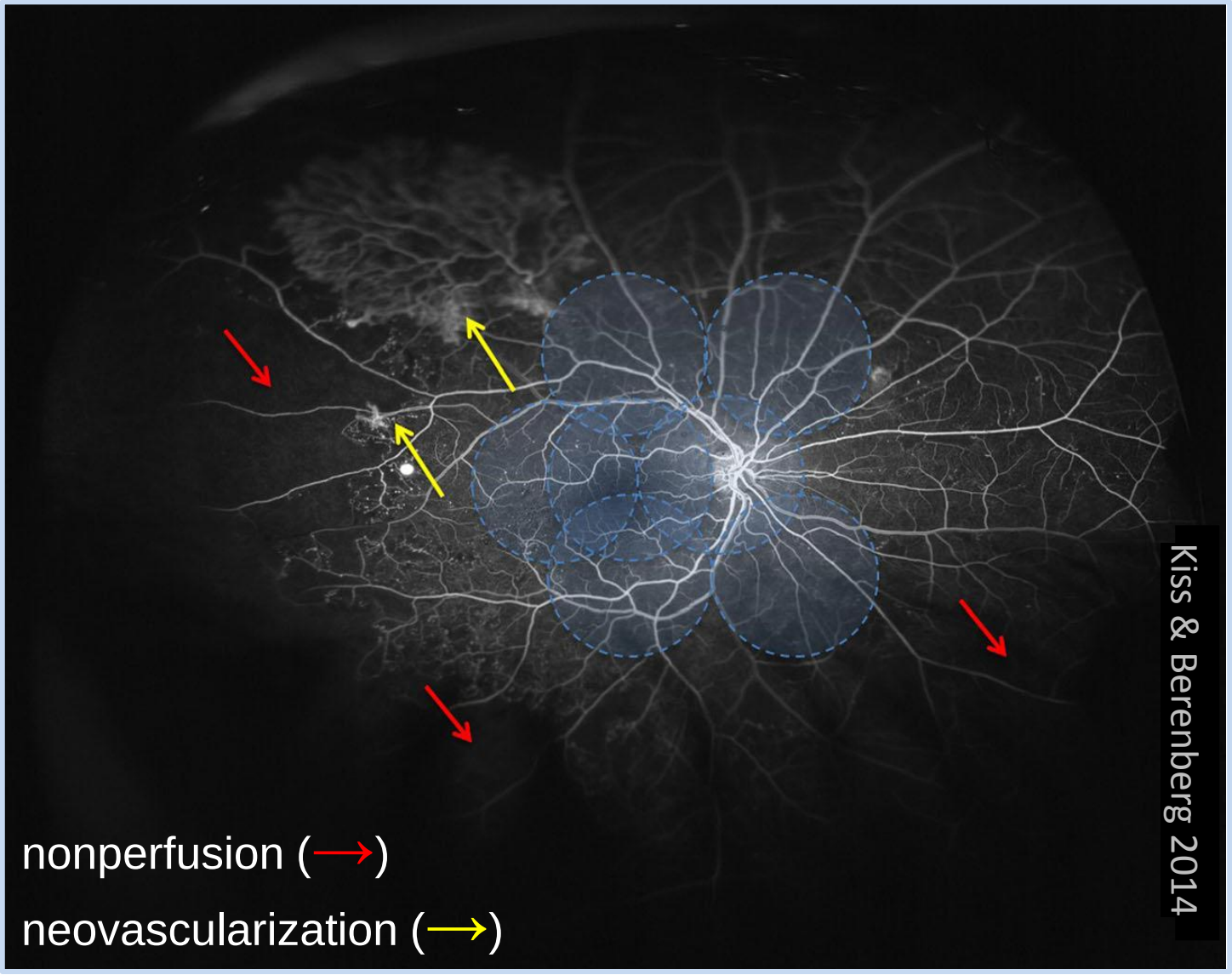
SLO Scanning laser ophthalmoscopy – uses laser. Miosis = no problem, like the (extreme) periphery

UWF – < 0.1% of referable DR would be missed ∧ reducing reading center burden (60%) *(Silva PS et al, Diabetes Care. 2014;37(1):50-55)*

UWF – non-inferior in grading DR to seven 45^0 ETDRS fields *(Rasmussen ML, Peto T, Grauslund J et al jdiacomp.2014.08.009)* and in determining DR and DME severity

UWF – compared to 7 ETDRS photos, Optomap increased DR severity grade in 15% of images *(Price LD et al Clin Ophthalmol. 2015;9:527-531)*

UWF-FA



Portable / hand-held / smartphone-based imaging

EyePhotoDoc –
$399 for iPad,
$299 for iPhone

Magnifi – $79.99
www.arcturuslabs.com

Orion SteadyPix Telescope Photoadapter
$47.99
www.telescope.com

Keeler Portable Slit Lamp iPhone 4 Image Adapter - $203
www.keelerusa.com

iExaminer
www.welchallyn.com

Zarf iPhone Adapter $520.75
Zarfenterprises.com
http://chelnyshops.ru/smartphone-fundus-camera/

Portable / hand-held / smartphone-based imaging

Dr Hong Sheng Chiong's medical company oDocs Eye Care has created an app-kit that performs a similar function to $50,000 worth of eye-examination equipment.
http://www.odocs-tech.com/

Portable / hand-held / smartphone-based imaging

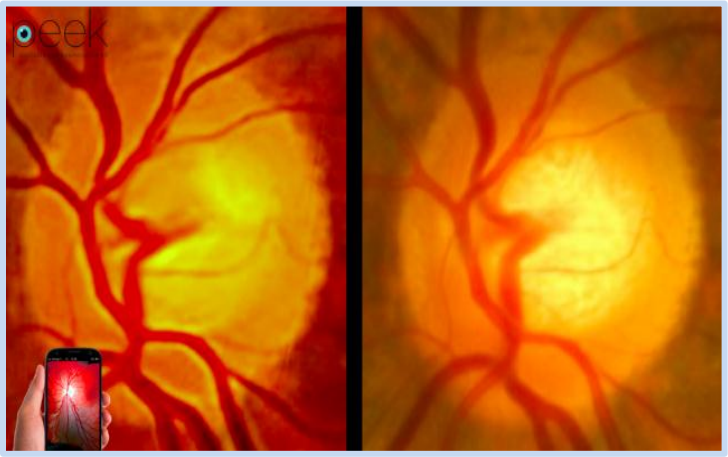
Dr. Hong Sheng Chiong: 40° field of view of the retina. A fundus machine replicated by a smartphone, a lens, and a handheld adaptor — all costing less than $50NZ.

Portable / hand-held / smartphone-based imaging

- A tech-focused eye-health company, **Peek Retina**, has had the foresight to design affordable smartphone apps that test for diseases such as cataracts and glaucoma as well as diabetes and high blood pressure – with the accuracy of a $25,000 camera, for only $100.

- Designed with non-specialists in mind

Portable / hand-held / smartphone-based imaging



Peek Retina was borne out of Bastawrous' frustration at having to transport bulky eye equipment to remote areas in Kenya during a community study as part of his PhD at the London School of Hygiene & Tropical Medicine.

The team saw a number of patients using both systems, the "gold standard" original kit and the smartphone option, and sent the results to Moorfields Eye Hospital, who decided both systems were comparable.

HOMEmade

blogspot.com

1. Smartphone with flash on option in the camera mode (in Still or video capture settings)
2. Smartphone's hard back cover
3. Condensing lens – 20 or 28 or 40 D
4. PVC pipe (40 mm dia)
5. PVC pipe reducers
6. Instant adhesive - Flex Kwik (Pidilite)
7. Light absorbing fabric (black in color) - (in this device, I used the Rexin like material cut from an old bag)
8. Sponge
9. Axo blade

It is assumed that the user already has a smartphone, its hard cover and the condensing lens **Total cost: Rs. 158.00**

HOMEmade

http://vitreoretinalsurgeon.blogspot.no/2015/05/presenting-worlds-first-do-it-yourself.html

HOMEmonitoring

Objective

HOMEmonitoring

myVisionTrack = example of *subjective* monitoring (software)

Requirements for screening

Single-field recommended for screening in 2004 (AAO) *Williams GA et al. Single-field fundus photography for diabetic retinopathy screening: a report by the American Academy of Ophthalmology. Ophthalmology. 2004;111:1055e1062.*

DR diagnostic sensitivity ≥ 80% and specificity ≥ 90% *(Royal College of Ophthalmology: Digital Retinopathy Guidelines, Dec. 2012)*

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Table 2 Relevant studies comparing UWF imaging to standard grading methods for diabetic retinopathy severity

Friberg et al [16]	UWF vs clinical exam	76 % sensitivity and 76 % specificity for DR
Neubauer et al [37]	UWF vs clinical exam	Sensitivity 94 % and specificity 100 % for more than mild NPDR; Sensitivity 89 %–93 % and specificity 72 %–89 % for CSME
Kernt et al [38]	UWF vs ETDRS 7SF	Good agreement, kappas of 0.70 and 0.66 for DR severity level and 0.68 and 0.74 for DME severity
Kernt et al [39]	UWF vs ETDRS 7SF	Good agreement, kappa 0.79, 0.77 for DR, and 0.73, 0.77 for DME
Silva et al [40]	UWF vs ETDRS 7SF	Exact agreement of DR severity in 70 % and within 1 level of DR severity in 93 %
Wilson et al [41]	UWF vs ETDRS 7SF (reference was slit lamp exam)	UWF images achieved a sensitivity of 83.6 % compared with 82.9 % for digital photographs in the ability to identify "referable disease"
Silva et al. [6]	UWF vs ETDRS 7SF vs clinical exam	Good agreement across all severity levels. UWF image more accurate 57 %. 60 % of total DR lesions evident ETDRS 7SF photographs. Peripheral lesions outside the ETDRS 7SF suggested a more severe assessment of DR in 10 % of eyes.

DME diabetic macular edema, *DR* diabetic retinopathy, *ETDRS* Early Treatment of Diabetic Retinopathy Study, *NPDR* nonproliferative diabetic retinopathy, *7SF* 7 standard field, *UWF* ultrawide field

Visualization…

High rate of new technologies being adapted; before large-scale quality assessment in every field of their potential use (like what happened to music: New music made on new machines due to availability/affordability, simultaneously re-defining «music»).

At present, UWF is at least broadening (!) our perspective of DR